Final Report to the NYS IPM Program, Agricultural IPM 2000-2001

Title: On Farm Trials of Alternative Controls for Striped Cucumber Beetles on Summer Squash

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Type of Grant: Pheromones; biorationals; microbials; conventional pesticides

Project Location:. Throughout the northeast

Abstract:

Alternate methods for striped cucumber beetle (SCB) control were trialed on zucchini summer squash at two commercial vegetable farms, one of which was managed organically. On the organic farm, Rotenone 5%WP, row cover, and Surround (a new kaolin clay-based product) were compared to an untreated control. On the conventionally managed farm, two treatments included the use of Invite, a cucurbitacin-based feeding stimulant. This stimulant was used with a reduced rate of Sevin 4F (carbaryl) and, in a separate treatment, a reduced rate of Rotenone 5%WP. The other treatments were Sevin 4F (regular rate), Surround, and an untreated control.

SCB pressure was very different at the two farms. On the conventional farm, SCB was first observed on May 25, while on the organic farm, SCB didn't show up until June 28. Pressure continued to be heavy on the conventional farm, but quickly fell on the organic farm.

On the conventional farm, the Sevin-sprayed plots had the most SCB beetles killed, the largest plants at first flowering, and highest yields. About 80% as many beetles were killed in the Sevin plus Invite (S+I) treatment, while only a few dead beetles were found on the Surround-sprayed plants and none in the control plots. The Surround, control, and S+I treatments were very similar in terms of plant size and yield. In the Rotenone plus Invite treatment, 5-20% as many SCB beetles were killed compared to Sevin, but plants were smallest and yields were significantly less than the other treatments.

On the organic farm, SCB played an insignificant role in plant growth and yield, though it has been a problem there in past years. A surprising result was that yields were retarded and reduced under the row cover treatment compared to the control. The reasons for this are unclear.

Background and Justification:

Early in the season, striped cucumber beetle (Acalymma vittatum) (SCB) is usually the main cucurbit insect pest of concern in New York State. The Cornell 2001 Integrated Crop and Pest Management Guidelines for Commercial Vegetable Production lists carbaryl (Sevin), imidacloprin (Admire), endosulfan (Thiodan), esfenvalerate (Asana), and permethrin (Ambush and Pounce) for control of SCB and its close relatives, spotted cucumber beetle and western corn rootworm (Diabrotica undecimpunctata and D. virgifera), on summer squash and other cucurbits. The latter three materials are restricted use pesticides, and Sevin is probably most commonly used on this ubiquitous pest. The use of Admire is increasing, and represents an important new control method. Unmanaged, SCB often transmits the serious disease, bacterial wilt (Erwinia tracheiphila).

Other materials are available and labeled in NYS which have the potential to control SCB, and have lower human toxicity and environmental impact. Among these is a kaolin clay product, Surround. Kaolin clay can be used as a food additive, under the category of "generally recognized as safe".

Rotenone is an option for organic producers, and has a relatively high human acute toxicity. It is only somewhat effective against SCB. One strategy to make it less hazardous and more effective would be to use it at a lower rate, along with a tank-mixed feeding stimulant material. Cucurbitacin-based SCB feeding stimulants are currently available--CideTrak (Trece), Invite (Florida Food Products), or Nu-Lure Insect Bait (Miller). Invite was used in this study.

This study began to determine the effectiveness and best use of these materials in NYS. Once full efficacy data is collected, the decision can be made whether to include them as recommended controls in the Pest Management Guidelines.

Summer squash is grown by about 25% of NYS diversified fresh market producers. While total NYS acreage is probably less than 1000, results of this study can be extended to other cucurbit crops. NYS cucumber acreage was 3600 for 1999. The total for all cucurbit crops, including pumpkins, cucumbers, summer and winter squash, and melons, is over 5,000.

This project includes selective, IPM-compatible pesticides, and thus falls within the Management Practice NYS IPM Research Priority.

Objectives:

1. To run controlled, replicated studies comparing the efficacy of kaolin clay (Surround), capsaicin (Hot Pepper Wax), and low rates of rotenone 5% WP plus bait [One of: CideTrak (Trece), Invite (FFP Agrotech), or Nu-Lure Insect Bait (Miller)] in comparison with the standard material, Sevin, or row cover exclusion for the control of striped cucumber beetle in summer squash.

2. Project evaluation--This project will be evaluated by whether it attains these objectives: 1) having its results accepted for publication, and 2) getting positive feedback from cooperating growers.

Note: After discussions with growers, the capsaicin treatment was dropped. Also, Invite acts as a feeding stimulant, not as an attractive bait.

Procedure:

This study was carried out in 2001 on zucchini in summer squash at two commercial vegetable farms. One used conventional, and one organic production methods. Experimental plots included four data plants plus two outer buffer plants, randomly replicated in four blocks on the outer row of a field.

The five treatments compared on the conventional farm were 1) kaolin clay (Surround), 2) low rate of Rotenone 5% WP plus Invite, 3) Sevin 4F applied at label rates, 4) low rate of Sevin 4F plus Invite, and 5) an untreated control. Two weekly spray applications were made starting when a threshold of one beetle per plant was reached. Sprays were discontinued at flowering. The variety, "Spineless Beauty" was grown.

Treatments on the organic farm were Rotenone 5%WP, row cover, Surround, and an untreated control. The row cover was applied when summer squash plants emerged, and removed at the onset of flowers. Three Surround sprays and two rotenone sprays were applied. Row cover was in place from 6/12 to 7/7, though it blew off at one point and had to be replaced. Probably because of this, a few SCB were seen under the row cover when it was removed. "Revenue" was the variety grown. Invite treatments could not be used on the organic farm due to organic certification restrictions.

Yield was measured by harvesting the four data plants from each replicate directly preceding a scheduled farm harvest. Plant size was collected by measuring the widest point of each of the data plants. Dead cucumber beetles were counted and removed from around the data plants after sprays on the conventional farm.

Table 1. Conventional Farm Field Operations

5/20	set transplants
5/24	mark treatments
5/25	SCB present, below threshold
5/30	row cover over whole planting vs. frost
6/4	remove row cover from test row
6/7	SCB over threshold; apply 1st sprays (small plants--low gallons/A): Surround--@5# per acre in 20 gal; Sevin 4F--@.4 qt. per acre in 20 gal; S+I--@.133qt./A Sevin 4F + 1 pt./A Invite in 15 gal; R+Invite--@.3#/A Rotenone + 1 pt./A Invite in 15 gal.
6/8	count dead SCB
6/13	apply 2nd sprays (same rates as 6/7)
6/18	count dead SCB
6/27	measure plants
7/2, 5, 6	early harvests
7/23, 25-26, 27	late harvests

Table 2. Organic Farm Field Operations

5/27 seed crop
6/12 mark treatments; apply row cover
6/18 thin plants; apply Surround (@5# per acre in 20 gal)
6/28 SCB present; apply Surround (@12.5# per acre in 50 gal)
6/30 apply Rotenone (@3# per acre in 50 gal)
7/2 measure plants
7/7 apply Surround and Rotenone (same rates); remove row cover
7/12, 17, 20, 24 harvests

Results and Discussion:

SCB pressure was very different at the two farms. On the conventional farm, SCB was first observed on May 25. It went over the threshold of one per plant on June 7 to trigger treatment applications. Pressure was heavy, and plants were sprayed two times. On the organic farm, SCB was first observed on June 28. However, two treatments were begun before that date. The row cover treatment started on June 12, shortly after seedling emergence. Surround was first applied on June 18, in an effort to build up a repellant coating before SCB arrived. SCB was at threshold on June 30, but after that populations declined, even on the control plants.

Table 3. Data Summary, Conventional Farm, 2001

Treatment	Dead SCB/plot 6/8	Dead SCB/plot 6/18	Plant Size 6/27	Yield 1 7/2-6	Yield 2 7/23-27
Control	0	0b	34.0ab	5.3	7.4
Sevin	20.5	53.8a	37.4b	8.0	8.2
Sevin/Invite	15.3	43.3a	35.7b	6.1	7.7
Surround	.5	.3b	33.7ab	5.2	8.0
Rotenone/Invite	4.8	2.5b	30.9a	2.9	5.8
ANOVA P	NS	.000	.025	NS	NS
LSD (Tukey-Kramer) P=.05		32.1	4.15		

Table 4. Data Summary, Organic Farm, 2001

Treatment	Plant Size 7/2	First Harvest 7/12	Total Early Yield
Control	32.7	3.2a	17.3a
Surround	33.1	2.9a	14.7ab
Rotenone	33.4	2.3ab	15.0a
Row Cover	34.6	0.3b	9.4b
ANOVA P	NS	.005	.007
LSD (Tukey-Kramer) P=.05		2.0	5.33

Based on single year trends, the findings from this study are:

!) The Sevin treatment had the highest beetle kill rate and tended toward the best yield under high SCB pressure
2) Invite plus a reduced rate of Sevin performed nearly as well
3) Invite plus a very low rate of Rotenone performed worse than the control
4) Surround performed similarly to the control on both farms
5) Row cover reduced early and total yield on the organic farm

A few items need further discussion. It appears that the effect of Invite is real, and that it can be a useful tool to intensify the effect of low rates of pesticides on SCB. Other approaches this suggests include using Invite with a highly attractive trap crop and low pesticide rate (or perhaps a full rate of Rotenone on organic farms) to further reduce pesticide use. It was a bit tricky to calibrate the reduced rate Invite treatments, since the label specifies very low gallon per acre rates for aerial application. Instead, a ground application @ 15 gallons/acre was used.

The Rotenone rates used was probably too low. The Rotenone label rate for SCB on cucurbits indicates "10#/100 gal per acre, or 1.6 fl.oz. per gallon". The 1.6 fl. oz. per gallon rate extrapolates to only about
6#/100 gal. Since 50 gal/A was the 1x (to runoff) spray rate in this trial, and since the "1.6 fl. oz. per gallon" rate was used to calculate experimental rates, a "full strength" rate of only 3#/A was used. This is likely too low for best effect. Similarly the reduced rate of .3#/A used with Invite was probably too low. A rate of 10#/50 gal/A seems consistent with the label, and would likely be more effective.

Surround showed little effect against SCB in this trial. Again, the rate used might have been low; but also, a weekly program, as indicated on the label, is not sufficient to maintain a coating of Surround on the fast-growing squash leaves. A twice a week spray schedule would be more likely to show a Surround effect against SCB, if there is one.

Spray costs are low for treating early-season squash plantings, since the plants are small and a narrow spray band and low per acre gallonage can be used. About 20 gallons of spray per acre, with a proportionally low amount of spray material, was used on most sprays. This compares to 50-100 gallons per acre typically used on crops with a full canopy. It appears that using a reduced insecticide rate plus Invite will not reduce cost, but can allow for a significant reduction in pesticide rate with good efficacy.

Table 5. Approximate Per Acre Costs

Surround 5#/A @ .70/#	= $3.50 per acre per spray*
Sevin .4 qt/A @ $25/gal	= $4.00/A/spray
Sevin, reduced rate .133 qt/A @ $25/gal	= $1.33/A/spray + Invite
Rotenone 3#/A @ $5/#	= $15.00/A/spray*
Rotenone, reduced rate .3#/A @$5/#	= $1.50/A/spray + Invite*
Invite 12-16 fl. oz./A;	estimated cost $10-15/A/spray

Floating Row Covers estimated cost $300/A/use, based on 3 uses per cover

* a higher rate might be more effective

While row cover costs to control SCB appear quite high, usually use of row covers also results in earlier yields. Farm squash yields in this study were on the order of 5-10,000 #/A/week, which at a low $0.20/# wholesale price means $1-2,000/A/week. Retail prices can be $1.00 or more per pound, especially for the baby size squash which comprised part of the harvest on the organic farm. So, an extra week of earlier production can be quite valuable. Other studies have shown summer squash to respond to row covers with earlier production. It is unclear why this one showed the opposite.

Many thanks to Mandeville Farm and West Haven Farm for hosting these trials.